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Pedro Miguel Aparício Chorão

Inhaler Devices in Asthma and COPD – An assessment of use and patient preferences

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Aos meus pais.

À minha irmã.

INHALER DEVICES IN ASTHMA AND COPD – AN ASSESSMENT OF USE AND PATIENT PREFERENCES

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Abstract

Background: Incorrect use of inhaler devices remains an obstacle for respiratory diseases management. We aimed to evaluate the frequency of inhaler technique errors; to determine the devices perceived as the easiest and favourite to use; to study the association of device type, demographics and patient preferences with inhaler technique (IT).

Methods: Cross-sectional assessment of 301 adults, with asthma (194) or chronic pulmonary obstructive disease, undergoing treatment with Aerolizer®, Autohaler®, Breezehaler®, Diskus®, Handihaler®, MDI without spacer, Miat-haler®, Novolizer®, Respimat® and/or Turbohaler®. Patients completed self-assessment questionnaires and face-to-face interview, with demonstration of inhaler technique. The rate of wrong steps (number of wrong steps ÷ number of total steps; RWS) was the primary outcome. Adjusted odds ratio (aOR) (95% confidence intervals [CI]) for presenting ≥1 IT errors were computed.

Results: From the 464 inhaler technique performances, the median RWS was 18%. Turbohaler® (21%) and Diskus® (19%) were chosen as easiest and Novolizer® (18%), Diskus® (18%), Turbohaler® (17%) as favourite for daily use. Females (aOR 2.68 [95% CI 1.55-4.65]; vs. males] and patients with >64 yr. (aOR 2.73 [95% CI 1.15-6.48]; vs <45 yr.) were more likely to perform IT errors; otherwise, no association was found, including with using the favourite device (aOR 1.43 [95% CI 0.84-2.42]).

Conclusion: The frequency of inhaler technique errors was high and no device was clearly preferred over the others. Using the preferred inhaler device was not associated with less errors.

Keywords: Asthma, COPD, inhaler device, inhaler technique, patient preference

Introduction

Inhaled therapy is the cornerstone in the management of asthma and chronic obstructive pulmonary disease (COPD). There are two main groups of inhaler devices: metered dose inhalers (MDI) and dry powder inhalers (DPI). Many devices have been developed and each has specificities on how to prepare the dose and deliver the drug to the airways. Although different devices have technological improvements to airway drug delivery, important limitations remain.[1] In fact, decades after the introduction of inhaler devices, their incorrect use remains an obstacle to achieve optimal disease outcomes.[2]

The correct use of inhaler devices is one of the most important aspects to be taken into account when evaluating individuals with asthma or COPD, and guidelines[3, 4] emphasize the importance of assessing inhaler technique to improve the efficiency of drug delivery. Furthermore, it is recognized that inadequate use of inhaler devices is one of the most common reasons for failure to achieve asthma control.[3] A recent review reports a high percentage of inhaler technique errors, but with great variability among studies.[5]

To understand how to improve the use of inhalers, different aspects have been studied, such as types of devices;[2, 6-9] patient factors (age, gender, education);[2, 8, 10, 11] and patient preferences.[7, 12] Yet, research results regarding the interaction between patient, device and technique are insufficient and inconsistent.

The aims of this study are: 1) to evaluate the frequency of errors in the inhaler technique of asthma and COPD patients; 2) to determine which inhaler device is perceived as the easiest and which is considered the favourite for daily use; 3) to study the association of device type, demographic characteristics and patient preference variables with inhaler technique.

Material and Methods

Study design and participants

This was a cross-sectional observational study, carried out in the Allergology and Pneumology outpatient clinics of the Centro Hospitalar São João, a tertiary university hospital in Porto, Portugal, from April to August 2013. Adult patients attending the outpatient clinics were invited to participate and were included if they had a medical diagnosis of asthma or COPD and were currently using an inhaler device. In this study, we assessed the most commonly used devices

from those available in Portugal: Aerolizer®, Autohaler®, Breezehaler®, Diskus®, Handihaler®, MDI without spacer, Miat-haler®, Novolizer®, Respimat® and Turbohaler®. Patients using different inhaler devices or those who were unable to read and/or write were excluded.

This study was conducted according to the principles of the Helsinki Declaration. Written informed consent was obtained from all participants. The study procedures were approved by the Ethics Committee of Centro Hospitalar São João. We have followed STROBE recommendations for reporting observational studies.[13]

Instruments and Data collection

Data were collected using a structured written questionnaire (filled autonomously by the patient) and a face-to-face interview.

First, the participant answered a questionnaire which evaluated the self-perception on his/her inhaler technique ("I perform correctly the technique of my inhaler"), satisfaction with the inhaler device, including comfort with public use ("I feel satisfied with my inhaler" and "I feel comfortable using my inhaler in public") and the perception on how his/her preferences were taken into account at the time of inhaler's prescription ("I feel that my physician took into account my opinion and preferences when choosing my inhaler"). These questions were answered using Visual Analogic Scales (VAS), ranging from 0 (worst) to 100 (best) millimetres.

On a second phase, each participant was asked to demonstrate the usual inhaler technique he/she followed with his/her current device(s), using a placebo inhaler. The inhaler technique for each device was evaluated using checklists based on the manufacturers' instructions available in the Portuguese drug agency database.[14] Summarized lists of the recommended inhaler steps for each device are presented in Supplementary Tables 1, 2 and 3. The interviewer registered if each step was performed properly and in an adequate order.

On a third phase, the interviewer explained the adequate inhaler technique for the participant's device(s) and demonstrated how to use the remainder inhalers. After the explanation and demonstration of use, each participant had the opportunity to test the available inhalers by him/herself.

Finally, each participant was asked to elect the device perceived as the easiest and the one they would prefer for daily use; the reason(s) underlying the choice of the inhaler for daily use were inquired through an open question.

The study questionnaire was pre-tested in 12 patients in order to check for readability and ease of understanding. To ensure uniformity of the assessment, all interviews were performed by the same trained interviewer. In order to reduce possible confounding related to differences in the therapeutic effect of inhaled drugs available for each device, it was explicitly stated, during the interview, that all questions were related only to the physical and functional aspects of the inhalers and not to the drug and/or its effects or safety.

Statistical analysis

The main outcome of this study was the rate of wrong steps (RWS), defined as number of inhaler technique wrong steps divided by the total number of recommended steps. We calculated the sample size based on the RWS. Considering a significance level of 0.05, we admitted a standard deviation for the RWS of 0.15, with a margin of error of 0.014. The sample size calculated for these parameters was 444 demonstrations of inhaler technique. Considering the same standard deviation of 0.15 for the RWS of each inhaler device, the inclusion of 40 demonstrations per device gives this study a power of 85% to detect a difference of 0.1 between the RWS of two different inhalers.

Categorical variables were described using absolute frequencies and proportions with 95% confidence intervals (95% CI); comparisons were performed using the Pearson chi-square test. For statistical analysis, age was recoded in three groups (<45; 45 to 64; and >64 years old) and the level of education was categorized according to the Portuguese education system (1 to 4; 5 to 9; 10 to 12; and >12 years of school education). Continuous variables were described using mean with standard deviation (SD) or median with interquartile range (IQR), as appropriate to the data distribution; comparisons were performed using non-parametric Mann-Whitney U and Kruskall-Wallis tests, as adequate. The inhalers used by less than 5% of total patients were not analysed individually except in what refers to the patient's preferences. The associations between the RWS and both VAS score and duration of inhaler use were studied with Spearman correlation coefficients (r^2). The level of significance was set at $p<0.05$.

Univariate logistic regression models were developed using independent variables as risk factors for "presence of errors in the inhaler technique". The univariate models considered all the available factors with a possible association with the inhaler technique, including patient characteristics (medical diagnosis, gender, age and school education), device features (type of device, time of use and number of different devices in use) and patient preferences regarding the devices that are considered the easiest and the favourite for daily use. Multivariate logistic

regression models were developed for the presence of errors in the inhaler technique. The factors with a p-value <0.250 in the univariate analysis were included in the initial multivariate model; the model was progressively adjusted considering its calibration (Hosmer-Lemeshow statistics), discriminative power (Area Under the Curve (AUC) from the Receiver Operating Curve (ROC)) and the adjusted p-value of each variable; a p>0.05 in the Hosmer-Lemeshow statistics was deemed necessary to consider that the model was calibrated. The final model included gender, age groups, years of school education and type of inhaler device; interactions (2x2) between different variables were tested but did not significantly improve the model and were not included. Results of both univariate and multivariate logistic regression models were presented as odds ratio (OR) with [95% confidence interval (95% CI)]. Statistical analysis was conducted using SPSS Statistics® version 21 for Windows (IBM SPSS, Chicago, IL, USA).

Results

Overall, 464 devices were being used by the 301 individuals included in the study. All the participants completed the study questionnaire and there was no missing data regarding individual questions.

The characteristics of the participants and their currently used inhalers are presented in Table 1 and 2, respectively. Turbohaler® and Diskus® were the most widely used devices, accounting for 27% and 19%, respectively, of all inhalers; Autohaler®, Breezhaler®, Miat-haler®, Novolizer® and Respimat® represented less than 5% of the devices in current use. Individuals with asthma used more frequently Turbohaler® (corresponding to 34% of total inhalers used in asthma), while most patients with COPD reported to use Handihaler® and Diskus® (26% and 21% of total COPD devices, respectively). Duration of use was, on average, similar between devices (mean [±SD] 4-5 [±4-5] years) except for MDI, which had been in use for a longer period (9 [±10] years). High grades were reported in the self-evaluation of inhaler technique (median 94%, p25-p75 74-94%) and satisfaction with the current device (median 87%, p25-p75 74-94%). Table 2 summarizes these results to each device. The scores regarding patient's perceived involvement in the choice of the device(s) and public use of the inhalers were also high (median 75%, p25-p75 26-96% and median 86%, p25-p75 48-97%, respectively).

Figure 1 shows the percentage of flawless inhaler technique performances and the distribution of the RWS for the most widely used inhaler devices. The frequency of errors at each

recommended step, discriminated by device, is presented in the Supplementary Tables 1, 2 and 3 available online.

When considering the preference on the easiest inhaler device, 56% of patients chose their current inhaler, 10% chose devices used in the past and 34% elected an inhaler they had never used. When considering the favourite device for daily use, 40% of participants chose their current device, 9% a device used in the past and most (51%) preferred a device they had never used. Figure 2 shows the proportion of patients reporting each device as the preferred (considering both the easiest and the favourite for daily use). Table 3 describes the reasons underlying the choice of an inhaler for daily use. Physical characteristics of the device were the most frequently reported motives for choosing an inhaler as the favourite (table 3); characteristics such as the colour control window present in Novolizer® (which provides feedback to the patient) and the compact format of Breezehaler® were referred, respectively, by 70% and 48% of the participants who selected Novolizer® and Breezehaler®, as the most important reasons for their choices.

Duration of use (p=0.253), perception of correct technique performance (p=0.106), satisfaction with the device (p=0.376), patient involvement by the physician (p=0.947) and comfort with the use of the device in public (p=0.607) did not significantly correlate with the RWS.

Females (vs. males, p<0.001), older individuals (>64 vs. ≤64 years old; p<0.001) and those with lower level of education (1 to 4 years vs. >12 years; p=0.001) had a higher RWS. The diagnosis of asthma or COPD (p=0.643), the number of different inhalers used (p=0.067), currently using the device chosen as the easiest to use (p=0.292) and currently using the favourite device (p=0.092) had no statistically significant association with the RWS.

Table 4 presents the odds ratio with 95% CI for inhaler technique with errors, based on the univariate and multivariate logistic regression analysis. Individuals who where not using their favourite device had no significant increase in the OR for the presence of at least one error in the inhalation technique (crude OR 1.43 [95% CI 0.84-2.42]; vs. already using the favourite device).

Discussion

In this cross-sectional observational study we observed a high RWS in inhaler technique and a corresponding low percentage of inhaler technique performances without errors. In multivariate analysis, females, elder patients and those using the Aerolizer® and Handihaler® devices had higher odds of performing errors. Other variables such as inhaler device factors (e.g.:

using more than one type of device), medical diagnosis, education and patient preferences, including using the preferred inhaler device, were not associated with correct inhaler technique. Finally, there was no consensus on the inhaler device to be considered as the 'easiest' or as the 'preferred for daily use'.

Our study comprehensively assessed factors that may affect performance of inhalation technique in asthma and COPD patients, using questionnaires and face-to-face interview, with demonstration of patient inhaler technique and demonstration to the patient of 10 different inhaler devices. Previously these factors have been described separately, such as type of inhaler device, disease, demographic characteristics and patient preferences. To our knowledge, this is the largest set of inhaler devices to be simultaneously assessed in a study. Nevertheless, this study has some limitations that should be considered. We could not compare all devices regarding the RWS, because some devices (Autohaler®, Breezehaler®, Miat-haler®, Novolizer®, Respimat®) were used infrequently. During the interviews we felt patients often had difficulties in separating previous experiences with medications from the devices that were used to deliver them, although it was explicitly said by the interviewer that only the physical and functional aspects of the device were being evaluated. Also, some participants might have not fully understood the VAS questions. Moreover, under or over reporting of inhaler technique errors due to interviewer bias can not be excluded, although using a single interviewer prevented inter-observer variability. Additionally, the study was conducted in a single healthcare institution and study design cannot exclude a selection bias; furthermore, illiterate individuals were excluded. This may render generalization of our results to other populations difficult.

A critical limitation to all studies evaluating inhaler technique is the lack of consensus regarding the methodology to assess and value errors. Other studies used several different methods such as critical errors,[2] essential steps,[6, 8, 9] grading systems[7] or error cut-offs.[10-12, 15] We calculated a rate of wrong steps, without valuing any particular steps. This method may overestimate the prevalence of incorrect use of inhaler devices, since it considers all steps recommended by manufacturers as a potential source of error, but it reduces the subjectivity of grading the relevance of some errors over the others in the absence of solid knowledge on the importance of each error on the distribution of the drug into the airways.

Inhaler technique assessment detected a high RWS across many of inhaler technique stages, which corresponded to low proportion of performances without mistakes. Despite the lower RWS in Turbohaler® and Diskus® comparing with other devices, no inhaler had an overall technique performance that surpassed all the others. Previous reports suggest that inhaler device

mishandling worsens the clinical outcome,[2, 15, 16] and therefore our data is motive of concern. Despite the differences in the inhalation technique, the choice of the inhaler device should be based on a physician-patient agreement, considering patient preferences, skills, availability of the intended drug, cost and physician experience.[1, 3, 4] An educational project on inhaler technique directed both to healthcare professionals and patients reported improved outcomes in asthma and COPD patients,[17] underlining the role the effectiveness of educational interventions. Other interventions suggest that education should be provided in a continuous[12] and interactive fashion.[16] Furthermore, evidence suggests that if the inhaler technique is performed correctly, similar outcomes can be achieved regardless of the type of inhaler device used by the patient.[18]

All inhaler devices included in this study had similar average durations of use, with the exception of MDI that had been used for a longer period of time. Hashmi *et al*[10] reported that there was no significant relationship between duration of inhaler use and the presence of errors in inhaler technique, which is in accordance with our data. Likewise, our results are in agreement with previous literature reporting that there is no difference in the performance of inhaler technique according to the number of inhaler devices in use.[2, 8] However, some authors reported more misuse amongst patients with multiple types of devices.[6, 9, 11]

A previous study by Melani *et al*[2] reported no statistically significant differences in inhaler technique between asthma and COPD patients, after adjusting for inhaler device, age and level of instruction. Our data support this lack of association. Nevertheless, they are discrepant with the results from Khassawneh *et al*;[6] in that study there is a report of higher odds of incorrect inhaler technique in COPD patients, after adjusting for age, gender and level of education, although the authors attribute the difference to older age and the presence of more comorbidities in COPD patients.

When considering demographic variables, we observed a higher odds ratio of poor inhaler technique in the elderly, as observed in previous studies.[2, 8] Moreover, our data suggests that females, when compared to males, present a greater odds of having incorrect inhaler technique. However, in what refers to gender, most of the published studies reported no differences in inhaler technique.[2, 8, 10, 11] This disagreement may be due to methodological differences, such as restricted analysis to specific errors[2, 8] or application of cut-offs to define correct technique.[10, 11] Nevertheless, it seems that female patients often have worse asthma control in spite of higher inhaled corticosteroid use[19] and COPD females seem to have more limitation, more dyspnoea and higher consumption of respiratory medication.[20] Inhaler technique may contribute to the different outcomes observed between genders, being an interesting factor to be elucidated in future studies.

An inverse relation between years of school education and incorrect inhaler technique was previously reported.[2, 10] We observed a similar trend in multivariate logistic regression analysis, with individuals with 5 to 9 years of school education presenting the highest OR for incorrect technique; however, individuals with higher level of school education were not significantly different from those with 1 to 4 years of education. Fayas *et al*[11] observed that knowledge on asthma and inhaler technique, but not the level of academic education, was associated with better inhalation techniques; in our study, no specific data on asthma knowledge was collected. Nevertheless, recently, the WHO Regional Office for Europe suggested school education as one of the many factors that influences health literacy;[21] this WHO manuscript did not include data from Portugal. Still, our observation seems to imply that physicians should not fully rely on the level of education as a predictor of correctness of inhalation technique.

Guidelines recommend considering patient's opinions and preferences regarding their inhaler device(s) and technique(s) when assessing inhalation technique.[3] Press *et al*[16] reported that patients over-estimate their inhaler technique. Our analysis supports these findings, since most patients were confident about the correctness of their inhaler technique performance and this self-perception was not significantly associated with a lower RWS. Additionally, we observed that higher satisfaction with the inhaler device, personal perspective of being engaged by the physician in the choice of the device and feeling comfortable to use inhaler devices in public had no significant influence on the performance of inhaler technique.

To study patient preferences, we compared ten inhaler devices to determine which was considered the easiest and the preferred for routine use but we could not identify an inhaler clearly favoured over the others. Interestingly, however, preferences seem to be greatly influenced by the prescription experience of our patients, since 66% chose the easiest device and 49% the preferred for routine use among those currently or formerly used.

When considering the motive(s) for choosing an inhaler device as the preferred for routine use, we observed that reasons and their relative representation varied across each device. This opposes a previous report on patient preferences that referred that ease of use was the leading reason underlying the patient's choice; nevertheless that study was not designed to assess motives.[7] The widely distributed preferences relating inhaler devices along with the existence of diverging reasons for the choice, indicates that prescription should not be standardized and that each patient must be considered individually.

Lenney *et al*[7] previously reported that prescribing the preferred device to the patient might improve inhaler technique. In that study, the authors recruited patients referred for inhaler assessment and evaluated inhaler technique for all the devices immediately after giving verbal instruction and demonstrating their use. In our study, data does not support an association between using the preferred inhaler device and the correctness of inhaler technique. However, we invited participants with different backgrounds of inhaler use from an outpatient clinic and inhaler technique was assessed prior to any demonstration from the interviewer, which represents a more reliable approach to a real-life clinical setting.

In conclusion, incorrect inhaler technique is frequent, especially in older patients and female patients. No inhaler device had a significant lower rate of wrong steps or was clearly preferred by the majority of the patients. Our data suggests that prescribing the patient's preferred inhaler is not associated with a better inhalation technique.

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Conflict of interests

Pedro Chorão and Ana M Pereira have no conflicts of interest to declare.

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Tables

Table 1 – Participants diagnosis, demographics and number of different inhalers used (n=301).

	All 301	
	n	**%**
Diagnosis		
Asthma	194	64
COPD	107	36
Gender (females)	181	60
Age (mean, SD)	53	17
< 45	90	30
45-64	132	44
>64	79	26
School years		
1-4	138	46
5-9	67	22
10-12	62	21
> 12	34	11
Number of current different inhalers		
1	166	55
2	108	36
≥3	27	9

Table 2 – Devices used, perception of correct technique and satisfaction with current inhaler (n=464).

Devices (n=464)	Frequency of use		Self-evaluation of correct technique*		Satisfaction with current device*	
	n	%	P50	(P25-P75)	P50	(P25-P75)
Turbohaler	128	27	86	(74-97)	79	(74-97)
Diskus	90	19	95	(74-97)	90	(74-97)
Handihaler	77	17	96	(75-97)	93	(74-97)
Aerolizer	64	14	96	(75-97)	93	(75-97)
MDI	54	12	92	(74-97)	92	(74-97)
Respimat	18	4	97	(76-97)	95	(74-98)
Novolizer	12	3	78	(74-97)	74	(50-94)
Breezehaler	11	2	96	(85-98)	96	(78-97)
Miat-haler	8	2	59	(12-97)	62	(8-75)
Autohaler	2	<1	62	(49-74)	50	(49-50)

Footnote: *Visual analogic scale, range 0-100(best).

Table 3 – Motives stated by participants for choosing a device as favourite for daily use, sorted by preference for daily use (see figure 2).

	Accustomed to		Easy		Practical		Physic Characterist.	
	18%		26%		26%		30%	
	n	%	n	%	n	%	n	%
Novolizer	1	1	5	8	6	9	54	82
Diskus	14	21	19	29	25	38	8	12
Turbohaler	27	44	9	14	15	24	11	18
MDI	9	21	18	41	14	31	3	7
Autohaler	1	4	18	67	6	22	2	7
Breezehaler	2	7	6	21	5	17	16	55
Aerolizer	5	23	9	41	6	27	2	9
Handihaler	5	26	4	21	7	37	3	16
Respimat	2	10	4	21	7	37	6	32
Miat-haler							2	100

Footnote: The reasons stated by the participants were grouped according to its general type: 'Practical' includes 'practical' and 'fast to use'; 'Physic Characterist.' includes 'colour control window' (only for Novolizer), 'small size', 'hygienic', 'dosage counter', 'design' and 'discretion'.

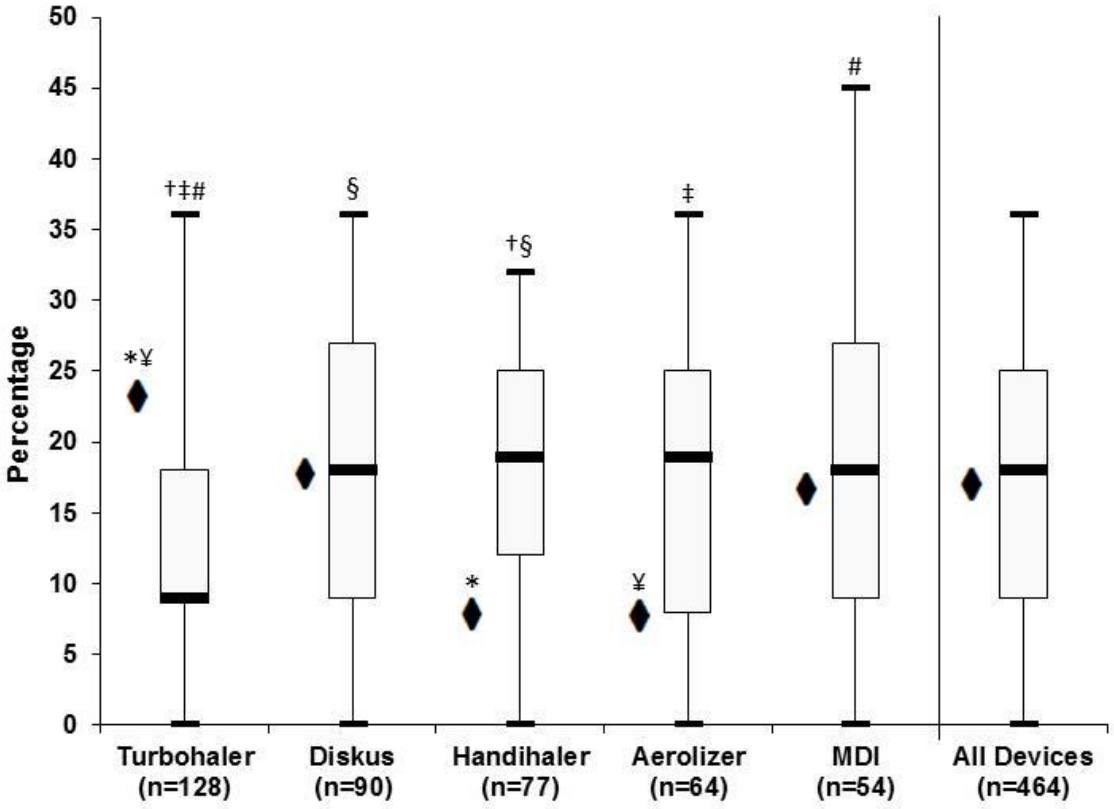
Table 4 – Odds ratio (OR) from univariate (crude) and multivariate (adjusted) logistic regression analysis for the presence of at least one error in the inhaler technique.

	Crude OR (95% CI)	Adjusted OR (95% CI)
Diagnosis		
Asthma	1.02 (0.62-1.66)	
COPD	Reference	NI
Gender		
Male	Reference	Reference
Female	2.01 (1.23-3.29)	2.68 (1.55-4.65)
Age groups (years)		
<45	Reference	Reference
45-64	2.18 (1.23-3.86)	2.29 (1.11-4.75)
>64	2.13 (1.12-4.06)	2.73 (1.15-6.48)
School years		
1-4	Reference	Reference
5-9	1.80 (0.86-3.76)	3.11 (1.31-7.37)
10-12	0.75 (0.40-1.40)	1.27 (0.57-2.86)
> 12	0.58 (0.28-1.21)	0.87 (0.36-2.09)
Number of diferent devices		
1	Reference	NI
>1	1.80 (1.10-2.94)	
Inhaler device		
Aerolizer	3.46 (1.27-9.42)	3.24 (1.13-9.32)
Diskus	1.36 (0.69-2.68)	1.51 (0.73-3.11)
Handihaler	3.47 (1.37-8.79)	3.71 (1.38-10.02)
MDI	1.47 (0.64-3.35)	1.07 (0.45-2.57)
Other	0.86 (0.40-1.82)	0.97 (0.43-2.18)
Turbohaler	Reference	Reference
Time of inhaler use (years)		
<1	Reference	NI
1 to 5	1.36 (0.73-2.53)	
>5	1.28 (0.65-2.53)	
Already using the easiest device		
Yes	Reference	NI
No	1.26 (0.77-2.08)	
Already using the favourite device		
Yes	Reference	NI
No	1.43 (0.84-2.42)	

Footnote: NI - Not included

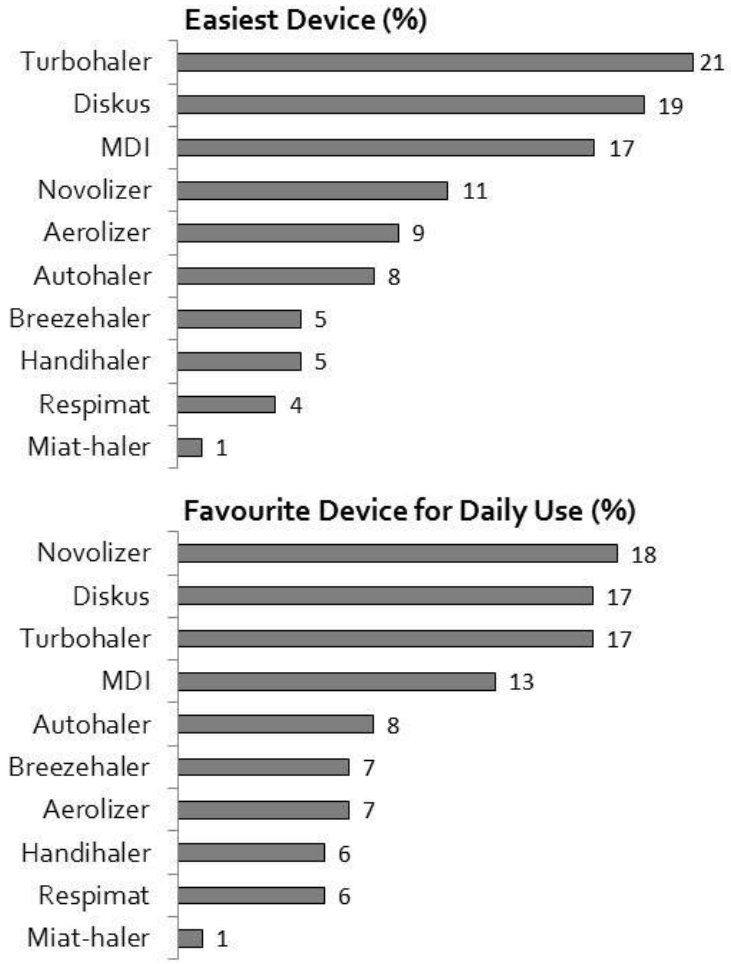
Figures

Figure 1 – Percentage of participants with flawless inhaler technique performances (diamonds) and distribution of rate of wrong steps (boxes and whiskers).



Footnote: Percentage of users with flawless inhaler technique performances is represented by the diamond symbol. Distribution of the rate of wrong steps (number of wrong steps ÷ total number of steps; RWS) for the more frequently used devices. Box represents 25-75 percentiles and rectangle box the median. Whiskers represent 5 and 95 percentiles. Pearson Chi-Square test was used to test for statistical significant differences in the percentage of flawless inhaler technique executions and Mann-Whittney U test was performed to test for statistically significant differences in the RWS. * p=0.006 for Turbohaler vs Handihaler. ¥ p=0.011 for Turbohaler vs Aerolizer. † p=0.001 for Turbohaler vs Handihaler. ‡ p=0.020 for Turbohaler vs Aerolizer. # p=0.015 for Turbohaler vs MDI. § p=0.038 for Diskus vs Handihaler.

Figure 2 – Percentage of patients reporting each device as the preferred, considering the easiest (left panel) and the favourite for daily use (right panel) devices, n=301 patient.



AGRADECIMENTOS

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Aos enfermeiros e técnicos do Serviço de Imunoalergologia e de Pneumologia do Centro Hospitalar São João, EPE, pelo acolhimento e por todo o apoio necessário ao desenvolvimento deste trabalho;

A todos aqueles que, com o seu estímulo, dedicação, amizade e paciência, tornaram possível a concretização deste projeto.

ANEXOS

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APÊNDICE

Supplementary Table 1 – Evaluation of technique errors in Aerolizer®, Breezehaler® and Handihaler®.

	Aerolizer 64		Breezehaler 11		Handihaler 77	
	n	%	n	%	n	%
1. Remove the protective cover						
2.0 Prepare the dose					2	3
2.1 Open the inhaler						
2.2 Insert the capsule and close					2	3
2.3 Perfurate the capsule once and release the lateral trigger(s)	19	30	4	36	27	35
2.4 Mouthpiece oriented upwards						
3.0 Exhale as much as confortably possible	31	48	2	18	32	42
3.1 Do not exhale into the mouthpiece	11	17	3	27	12	16
4.0 Inhale rapid and forcefully	21	33	2	18	20	26
4.1 Inhale only through the mouth			1	9	1	1
4.2 Close the lips around the mouthpiece						
4.3 Do not cover the air entrance holes	7	11	3	27	NA	NA
5. Apnoea after inhalation	23	36	2	18	11	14
Hold breath at least 10 seconds	20	31	3	27	39	51
6. Exhale naturally					1	1
6.1 Do not exhale into the mouthpiece	2	3			6	8
7. Repeat steps 3 through 6	NA	NA	NA	NA	31	40
8. Open the inhaler and check if there is any medication left in the capsule	11	17			21	27

Footnote: NA – Not applicable. Blank spaces represent steps with no errors observed.

Error in step 2.3 was considered when patient primed the lateral trigger more than once. Only 2 patients using Handihaler failed to perform step 2.3. For step 5. the apnoea period was evaluated and two types of error were considered (holding breath for less than 10 seconds and expelling air immediately).

Supplementary Table 2 – Evaluation of technique errors in Diskus®, Miat-haler®, Novolizer® and Turbohaler®.

	Diskus (n=90)		Miat-haler (n=8)		Novolizer (n=12)		Turbohaler (n=128)	
	n	%	n	%	n	%	n	%
1. Open the inhaler								
2. Prepare the dose			5	63			13	19
3.0 Exhale as much as confortably possible	27	30	3	38	1	8	36	28
3.1 Do not exhale into the mouthpiece	24	27	1	13	2	17	28	22
4.0 Inhale rapid and forcefully	26	29	5	63	2	17	24	19
4.1 Inhale only through the mouth							3	2
4.2 Close the lips around the mouthpiece	1	1	1	13	1	8	1	1
5. Apnoea after inhalation	14	16	3	38	2	17	19	15
Hold breath at least 10 seconds	37	41	3	38	5	42	46	36
6. Exhale naturally							3	2
6.1 Do not exhale into the mouthpiece	9	10					10	8

Footnote: NA – Not applicable. Blank spaces represent steps with no errors observed.

In Diskus dose preparation was evaluated by pulling down the trigger, in Novolizer by the colour change in the indicator, in Miat-haler by pressing the lid fully down and then upwards and in Turbohaler by full rotation and counter-rotation. In Novolizer, rapid and forcefully inhalation was evaluated by the colour change in the indicator. For step 5. the apnoea period was evaluated and two types of error were considered (holding breath for less than 10 seconds and expelling air immediately).

Supplementary Table 3 - Evaluation of technique errors in MDI without spacer, Autohaler® and Respimat®.

	MDI		Autohaler		Respimat	
	54		2		18	
	n	%	n	%	n	%
1. Prepare the dose (Autohaler: Step 2)	NA	NA				
2. Remove the protective cover						
3. Shake the inhaler	20	37	NA	NA	NA	NA
4. Exhale as much as confortably possible	19	35			8	44
5.0 Inhale slow and deeply	2	4				
5.1 Coordinate the beggining of the inhalation with the firing of the inhaler	5	9	NA	NA	4	22
5.2 Continue to inhale after firing the inhaler	13	24			5	28
5.3 Inhale only through the mouth	3	6				
5.4 Close the lips around the mouthpiece	1	2				
5.5 Hold the inhaler upright (MDI/Autohaler) or horizontally (Respimat)	1	2				
5.6 Do not cover the air entrance holes	NA	NA	NA	NA	5	28
6. Apnoea after inhalation	6	11			5	28
Hold breath at least 10 seconds	34	63	1	50	7	39

Footnote: NA – Not applicable. Blank spaces represent steps with no errors observed.

In Autohaler preparing the dose consisted in placing the valve upwards with the inhaler held upright and in Respimat rotating the base 180° degrees. For step 5. the apnoea period was evaluated and two types of error were considered (holding breath for less than 10 seconds and expelling air immediately).

Questionário

Dados sociodemográficos:

Sexo: ☐ Feminino ☐ Masculino

Idade:____

Escolaridade:_____

Dados relativos à doença:

- Diagnóstico:_____

Número	Inalador	Tempo de Utilização	Actual
			☐
			☐
			☐
			☐
			☐

Inquérito 1

As seguintes perguntas pretendem saber a sua opinião relativamente à parte prática da utilização do seu inalador (se a técnica é fácil ou difícil) e ao seu aspecto físico (como, por exemplo, a forma ou o tamanho).

Nenhuma pergunta se refere ao efeito que o medicamento (que se encontra dentro do inalador) tem nos seus pulmões e o que sente após a sua utilização.

Inalador:_____

Uso correctamente a técnica do meu inalador:

Totalmente Incorrecto — Totalmente Correcto

Sinto-me satisfeito com o meu inalador:

Totalmente Insatisfeito — Totalmente Satisfeito

Inalador:_____

Uso correctamente a técnica do meu inalador:

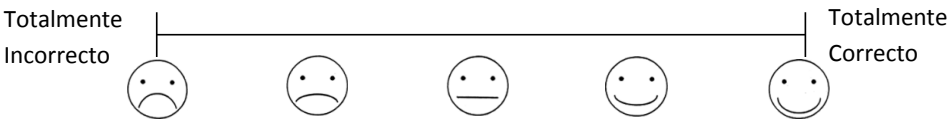
Totalmente Incorrecto — Totalmente Correcto

Sinto-me satisfeito com o meu inalador:

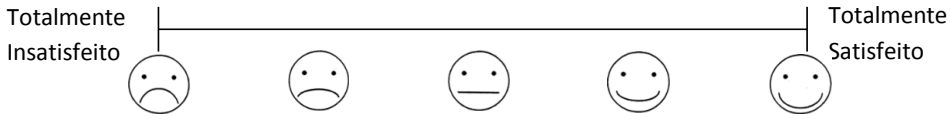
Totalmente Insatisfeito — Totalmente Satisfeito

Uso correctamente a técnica do meu inalador:

Inalador:_____

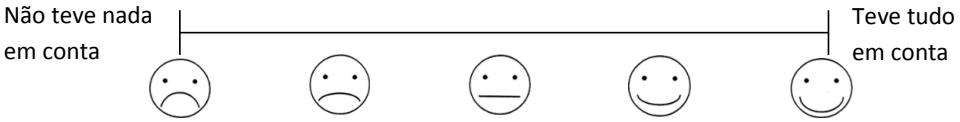


Sinto-me satisfeito com o meu inalador:

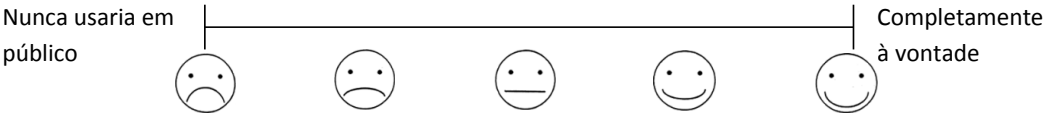


Inquérito 2

Senti que o médico teve em conta a minha opinião e preferências na escolha do meu inalador:



Sinto-me confortável em usar o meu inalador em público:



Pós Intervenção:

De todos os inaladores observados:

- Mais fácil de usar no dia a dia:_____
- Caso pudesse tomar a medicação em qualquer dispositivo, qual escolheria:_____
    - Motivos:_____

DPI – Aerolizer

Asmatec [UCB Pharma], Foradil [Novartis Farma], Formeterol Generis [Generis], Formeterol Winthrop [Winthrop], Miflonide [Novartis Pharma]

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☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:
☐	☐	☐	---	6. Expirar normalmente Não expirar para o bocal Comentário:
☐	---	---	☐	7. Abrir o inalador e verificar se há fármaco na cápsula Comentário:

MDI – Autohaler

Inaladores: Qvar Autohaler [Teva Pharma]

Correto	Parcialmente Incorreto	Incorreto	Não realiz.	Passos
☐	---	---	☐	1. Remover a cobertura do bocal Comentário:
☐	☐	☐	☐	2. Preparar a dose Acionar a válvula para cima Dispositivo na vertical Comentário:
☐	---	☐	---	3. Expirar até onde for confortável Comentário:
☐	☐	☐	---	4. Inalar a dose lenta e profundamente Continuar a inspiração após libertação da dose Inalar pela boca apenas Cerrar os lábios em volta do bocal Dispositivo na vertical Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:

DPI – Breezehaler

Inaladores: Hirobriz [Novartis Europharma], Onbrez [Novartis Europharma], Oslif [Novartis Europharma]

Correto	Parcialmente Incorreto	Incorreto	Não realizado	Passos
☐	---	---	☐	1. Remover a tampa protetora Comentário:
☐	☐	☐	☐	2. Preparar a dose Abrir o inalador Colocar a cápsula e fechar Perfurar a cápsula 1 vez e libertar os botões laterais Bocal orientado para cima Comentário:
☐	☐	☐	---	3. Expirar até onde for confortável Não expirar para o bocal Comentário:
☐	☐	☐	---	4. Inspirar rápido e profundamente Inalar pela boca apenas Cerrar os lábios em volta do bocal Não ocluir os orifícios de entrada de ar Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:
☐	☐	☐	---	6. Expirar normalmente Não expirar para o bocal Comentário:
☐	---	---	☐	7. Abrir o inalador e verificar se há fármaco na cápsula Comentário:

DPI – Diskus

Asmatil Inalador [Alter], Asmo-Lavi [Laboratórios Vitória], Brisomax Diskus [Bial], Brisovent Inalador [Bial], Dilamax Diskus [Bial], Flixotaide Diskus [Glaxo Wellcome], Maizar Diskus [Laboratórios Vitória], Seretaide Diskus [Glaxo Wellcome], Veraspir Diskus [Alter]

Correto	Parcialmente Incorreto	Incorreto	Não realizado	Passos
☐	---	---	☐	1. Abrir o inalador Comentário:
☐	---	☐	☐	2. Preparar a dose Comentário:
☐	☐	☐	---	3. Expirar até onde for confortável Não expirar para o bocal Comentário:
☐	☐	☐	---	4. Inspirar rápido e profundamente Inalar pela boca apenas Cerrar os lábios em volta do bocal Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:
☐	☐	☐	---	6. Expirar normalmente Não expirar para o bocal Comentário:

DPI – Handihaler

Inaladores: Spiriva [Boehringer Ingelheim]

Correto	Parcialmente Incorreto	Incorreto	Não realiz.	Passos
☐	---	---	☐	1. Remover a tampa protetora
				Comentário:
☐	☐	☐	☐	2. Preparar a dose
				Abrir o inalador
				Colocar a cápsula e fechar o bocal
				Perfurar a cápsula 1 vez e libertar o botão lateral
				Bocal orientado para cima
				Comentário:
☐	☐	☐	---	3. Expirar até onde for confortável
				Não expirar para o bocal
				Comentário:
☐	☐	☐	---	4. Inspirar rápido e profundamente
				Inalar pela boca apenas
				Cerrar os lábios em volta do bocal
				Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos
				Comentário:
☐	☐	☐	---	6. Expirar normalmente
				Não expirar para o bocal
				Comentário:
☐	---	---	☐	7. Repetir os passos 3 a 6
				Comentário:
☐	---	---	☐	8. Abrir o inalador e verificar se há fármaco na cápsula
				Comentário:

MDI – Clássico

Inaladores: Asmatil Inalador [Alter], Asmo-Lavi [Laboratórios Vitória], Atimos [Angelini], Atrovent PA [Boehringer Ingelheim], Beclometasona Generis [Generis], Berodual PA [Boehringer Ingelhem], Brisomax Inalador [Bial], Brisovent Inalador [Bial], Budenosido Generis [Generis], Dilamax Inalador [Bial], Flixotaide [Glaxo Wellcome], Maizar Inalador [Laboratórios Vitória], Pulmicort Inalador [AstraZeneca], Salbutamol Generis [Generis], Seretaide Inalador [Glaxo Wellcome], Serevent Inalador [Glaxo Wellcome], Ventilan [Glaxo Wellcome]

Correto	Parcialmente Incorreto	Incorreto	Não realiz.	Passos
☐	---	---	☐	1. Remover a tampa protetora Comentário:
☐	---	---	☐	2. Agitar o inalador Comentário:
☐	---	☐	---	3. Expirar até onde for confortável Comentário:
☐	☐	☐	---	4. Inalar a dose lenta e profundamente Coordenar libertação da dose com início da inspiração Continuar a inspiração após libertação da dose Inalar pela boca apenas Cerrar os lábios em volta do bocal Dispositivo na vertical Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:

DPI – Miat-haler

Inaladores: Budesonida Farmoz [Tecnimede], Budesonido Tecnicort [Tecnimede]

Correto	Parcialmente Incorreto	Incorreto	Não realiz.	Passos
☐	---	---	☐	1. Remover a tampa protetora Comentário:
☐	---	☐	☐	2. Preparar a dose (premir botão até ao fim) Comentário:
☐	☐	☐	---	3. Expirar até onde for confortável Não expirar para o bocal Comentário:
☐	☐	☐	---	4. Inspirar rápido e profundamente Inalar pela boca apenas Cerrar os lábios em volta do bocal Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:
☐	☐	☐	---	6. Expirar normalmente Não expirar para o bocal Comentário:

DPI – Novolizer

Inaladores: Budenosido Novolizer [Meda Pharma], Formeterol Novolizer [Meda Pharma]

Correto	Parcialmente Incorreto	Incorreto	Não realiz.	Passos
☐	---	---	☐	1. Remover a tampa protetora Comentário:
☐	---	☐	☐	2. Preparar a dose (cor do indicador muda para verde) Comentário:
☐	☐	☐	---	3. Expirar até onde for confortável Não expirar para o bocal Comentário:
☐	☐	☐	---	4. Inspirar rápido e profundamente Inalar pela boca apenas Cerrar os lábios em volta do bocal Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:
☐	☐	☐	---	6. Expirar normalmente Não expirar para o bocal Comentário:

MDI – Respimat

Inaladores: Spiriva Respimat [Boehringer Ingelheim]

Correto	Parcialmente Incorreto	Incorreto	Não realiz.	Passos
☐	---	---	☐	1. Preparar a dose (rotação da base do inalador) Comentário:
☐	---	---	☐	2. Abrir a tampa de proteção
☐	---	☐	---	3. Expirar até onde for confortável Comentário:
☐	☐	☐	---	4. Inalar a dose lenta e profundamente Coordenar libertação da dose com início da inspiração Continuar a inspiração após libertação da dose Inalar pela boca apenas Cerrar os lábios em volta do bocal Dispositivo na horizontal Não ocluir os orifícios de entrada de ar Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:

DPI – Turbohaler

Inaladores: Assimie Turbohaler [Tecnifar], Bricanyl Turbohaler [AstraZeneca], Oxis Turbohaler AstraZeneca], Pulmicort Turbohaler [AstraZeneca], Symbicort Turbohaler [AstraZeneca]

Correto	Parcialmente Incorreto	Incorreto	Não realiz.	Passos
☐	---	---	☐	1. Remover a tampa protetora Comentário:
☐	---	☐	☐	2. Preparar a dose (rotação e contra-rotação) Comentário:
☐	☐	☐	---	3. Expirar até onde for confortável Não expirar para o bocal Comentário:
☐	☐	☐	---	4. Inspirar rápido e profundamente Inalar pela boca apenas Cerrar os lábios em volta do bocal Comentário:
☐	---	☐	☐	5. Suster a respiração durante 10 segundos Comentário:
☐	☐	☐	---	6. Expirar normalmente Não expirar para o bocal Comentário: